DOCUMENT RESUME

ED 192 261 CS 005 632

AUTHOR Pine, Cathy K.; Bieger, George R.
TITLE Methodological Issues in Research Involving Pictures and Texts.
PUB DATE Apr 80
NOTE 15p.; Paper presented at the Annual Meeting of the American Educational Research Association (Boston, MA, April 7-11, 1980).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; *Discourse Analysis; Illustrations; Information Needs; *Instructional Materials; Organization; *Pictorial Stimuli; *Reading Comprehension; *Research; Research Methodology; Research Needs; Research Problems
IDENTIFIERS *Directions; *Instructions

ABSTRACT

A method was developed for characterizing and comparing the semantic content of picture-text combinations used as stimuli in research on reading procedural instructions. The written directions for assembling a toy model were analyzed, and sets of propositions in the instructions were constructed using C. H. Frederiksen's discourse analysis model. Using the same model, written descriptions of pictures were consolidated and then reduced to sets of interrelated propositions. A comparison of the two sets resulted in revisions of text and pictures to obtain redundancy of essential information. Three general types of information were identified as "core" components of both forms: locative, referential, and sequential information. Stimulus materials attempting to emphasize each type of information in both text and pictures have been prepared and are being tested. So far the results of such testing have produced the following observations: (1) the linear nature of text makes core sequential information inherent, so manipulation of sequential information is difficult and may destroy the integrity of the instructions; and (2) core locative information is inherent in pictures and cannot be manipulated without changing the essence of the messages. (RL)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED192261

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

# Methodological Issues In Research Involving Pictures and Texts

Cathy K. Pine

and

George R. Bieger

Cornell University

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Cathy K. Pine

George R. Bieger

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Paper presented at the annual meeting of the American Educational Research Association, Boston, April, 1980.

CS005632

# Methodological Issues In Research Involving Pictures and Text

The cognitive processes involved in extracting information from textual materials have long been the subject of research in education and psychology. The majority of such studies have focused on the reading process exclusively and have not, for the most part, addressed the relationship between pictures and text as conveyors of information. Thus, the direct application of previous research findings to many types of instructional materials is difficult since most textbooks, as well as technical manuals, provide information in the form of graphics and text.

One particular area where few studies were found to exist was in the use of pictures as adjuncts to technical instructions. This is somewhat surprising in light of the large number of illustrated procedural materials in use. Nonetheless, of the relatively small body of research that has studied "picture-text amalgams" (Hochberg, 1968), most has been done with narrative materials and has focused on the question of whether illustrations enhance or detract from comprehension of stories in basal readers.

Such studies have often yielded contradictory results. Pictures have been found to improve children's comprehension of stories (Halbert, 1943); make no difference in comprehension of stories (Miller, 1938; Vernon, 1953; Koenke, 1968); and, to hinder comprehension by being distractions (Fries, Fries, Wilson, & Rudolph, 1965; Chall, 1967; Samuels, 1970) and by presenting ambiguous information (Mackinnon,1959; Gombrich, 1972).

One reason for these conflicting results may be the lack of precise descriptions of the textual and pictorial materials used in each study. A clear specification of the information presented in each media format, the relationship between the information in each format, and the nature of the information tested in the evaluation instrument, may reveal a variety of uncontrolled stimulus variables directly affecting the comprehension process. Hence, any investigation of the comprehension of information presented in materials made up of picture-text combinations must address these methodological difficulties.

A concern with critical aspects of the semantic content of reading materials is reflected in much current research into the psychological processes involved in reading, most notably in research on the structure of discourse (Glaser, 1979). Research into the comprehension and memorial processes of readers has been aided by the use of text or prose grammars (Kintsch, 1974; Meyer, 1975;), which have enabled researchers to identify the basic semantic constituents of a prose passage and to specify both the explicit and the implicit semantic relationships among these constituents. These models of text analysis have demonstrated their utility in identifying certain stimulus variables which affect the memorability of information and as such have been shown to be useful analytic and predictive tools for reading research. However, when the stimuli consist of picture-text combinations, the problems of specifying the semantic information contained in each form are magnified.

Of the research which has attempted to examine the cognitive

processes involved in extracting information from pictures and verbal materials, most has been limited to experiments using picture-word pairs. This approach is inadequate for many of the same reasons that words in isolation or even individual sentences were found to be inadequate units for the analysis of the meaning conveyed in text. The role of surrounding context as a contributor to meaning has been well established, and this context is often even more important when a reader tries to acquire information from picture-text combinations (Bransford and Johnson, 1973). The realization that the interrelationship among ideas is a major contributor to the meaning of a text passage was one of the principle motivations for the development of prose grammars. However, text-based prose grammars, for the most part, are appropriate to expository text, rather than technical or procedural materials; and, none have been used to represent pictorially presented information. Since our general area of investigation concerns the use of procedural instructions (containing both pictures and text) it was necessary for us to develop a method for the analysis of pictures and procedural text. The remainder of this paper will describe the methods we used for the analysis of the information presented in procedural picture-text combinations.

## Procedure

The task chosen for investigation in this series of studies was the assembly of a small model from a Fischer-Technik (100) model kit.

(Although similar in design to toy model sets available in the United States, such as Tinker Toys or Erector Sets, this model kit is produced in Germany and unfamiliar to most Americans.)

Preparation and Validation of Instructions

First, a set of written (i.e. text) instructions was produced. These instructions were pilot tested on several individuals to assess their clarity and completeness for accurate construction of the model. Next, pictures were designed by an artist following the text directions. These pictures were intended to be semantically redundant with respect to the text. Finally, the pictures alone were then pilot tested to assess their independence from the text as complete and accurate conveyors of the necessary assembly instructions. These procedures were described by Stone (1977). At this point, text and illustrations were each known to contain all necessary and sufficient information for the accurate performance of the assembly task. However, the specific semantic content of each remained unspecified.

Description of Semantic Content

In order to specify the semantic content of both text and pictures in comparable terms, an adaptation of the discourse analysis model first proposed by Frederiksen (1975) was used. First, the text instructions were coded into an ordered list of propositions based on the modified Frederiksen system (Dee-Lucas, 1978). Next, the pictorial instructions were given to volunteers who provided written descriptions of each picture. These written descriptions were also

coded into an ordered list of propositions using the modified Frederiksen model. The two lists of propositions were compared and several modifications were made to both text and pictures. After validation by pilot testing, it was felt that a "core" of redundant information was present in both pictures and text, which was describeable in a comparable manner, and which was necessary and sufficient for successful completion of the assembly task.

Rationale for Frederiksen Model and Example of Use

The Frederiksen (1975) model of discourse analysis was selected for use in this series of pilot studies because it alone, of the widely used discourse analysis models, claimed to represent knowledge by means of semantic and logical networks which were defined independently of any linguistic system, and, therefore, it could be used to represent semantic information from non-linguistic sources (e.g. pictures, actual events) as well as from prose passages. In this network system, the semantic content and structure of pictures or text can be represented through specification of the different concepts present in the materials, and the particular relationships among these concepts. Each concept is represented by a node in the network structure; a relationship is represented as the connection between two nodes. Each concept-relation-concept triple defines a unique proposition.

The following instruction, taken from our assembly task, will serve as as example of our propostional coding scheme.

To form a handle: Insert a short rod through a clip so that the clip is in the middle of the rod.

```
P1.1   (  )--AGT-->('form)
P1.2   ('form)--OBJ-->(:handle)
P2.1   (  )--AGT-->('insert)
P2.2   ('insert)--OBJ-->(:short.rod)
P2.3   (:short.rod)--LOC@p('through)-->(:clip)
P3.1   (:clip)--LOC@p('in.the.middle.of)-->(:short.rod)
P4.1   P2--GOAL-->P3
P5.1   P4--GOAL-->P1
```

In this example, concepts are coded in parentheses and arrows linking two concepts are labled with the appropriate relation (AGT = agent, OBJ = object, LOC = locative). Concepts preceded by an apostrophe have been classified as functionally "primitive" concepts, that is they need no further decomposition for this level of reader. Concepts preceded by a colon are those which were included on a list of objects whose name and description were learned by the subject prior to the task. Empty parentheses represent implicit concepts, in this case the implied agent of the action. Finally, the concept following "@p", is a "pseudo-qualifier" which further explains the locative relationship between the other two concepts in that proposition. A more detailed explanation of the procedures and conventions used in this system, as well as complete definitions for the terms used, has been compiled by Dee-Lucas (1978).

## Discussion

With the adoption of several conventions for such tasks as labeling and referring to propostions, the procedure described above was found to be both an easily used and easily taught system for decomposing large units of text into their constituents. The use of verbal descriptions of pictures as the basis for identifying the information available in that picture seemed to be a reliable and accurate method. Comparing the descriptions provided by all volunteers, and noting the frequency with which an idea (coded as a proposition) was mentioned, showed that there was nearly complete agreement regarding "essential" information (that is, the information necessary to perform the assembly, or what we called the "core" propositions).

Allowing for the use of equivalent wording, such as synonyms and paraphrases, the phraseology produced by the volunteer describers was often strikingly similar to that found in the textual portion of the instructions. This is not surprising in light of the large number of procedural instructions that are present in most people's experience, and in light of the high degree of similarity in many procedural instructions.

Pictures obviously provided information in addition to that which was necessary for the accurate completion of the task, but this information was not mentioned in the descriptions as frequently as the "core" propositions, and typically was information describing the

appearance of objects, or aspects of their physical orientation, not relevant to the assembly.

An interesting aspect of the descriptions relates to the instructions given to the volunteers prior to the session. One group of people were told merely to describe the pictures they were given. Their descriptions therefore, were stative, that is, they said things such as, "The large block is connected to the small block". Another group of people was asked to describe the steps that they would follow in order to produce what was in the picture. These descriptions were, not surprisingly, more processive, that is, they said things such as, "Connect the large block to the small block". Despite these surface differences, the actual content of the pool of described information, including the interpropositional relationships, was the same for both groups.

Confident that we had obtained pictures and texts that provided the same information and which could be represented in a comparable manner, we attempted some initial manipulations of the information. Stone (1978) described certain broad categories of information, which could plausibly affect comprehension depending on the media form of their presentation. These categories included locative, referential, and sequential information. Locative information refers generally to those propositions which express a relation of location, orientation, or spatial relationships among concepts. Referential information includes those concepts which name objects, their parts, or sub-assemblies constructed from several objects. Sequential information refers to that aspect of the instructions which specifies

the order in which the different steps of the assembly procedure must be performed for the task to be correctly completed.

Our manipulation consisted of first identifying the propositions of each category, and then emphasizing one category or another. Initially we emphasized only the information that was in the textual portion of the instructions. This was done by underlining and capitalizing the letters in the words which transmitted the target information. The use of underlining and capitalization as methods of adding emphasis to text was supported by examining subjects eye movements while they read different versions of the text. Emphasized portions of the text received more attention, as evidenced by longer fixation durations, than did non-emphasized portions of the text (see Table 1). Whether or not this increased duration of fixation translates into increased comprehension and/or memory, is a subject which we intend to investigate in the series of studies currently being conducted. (N.B. These results are very tentative and because they represent data from pilot studies were not subjected to statistical analysis.)

---

Insert Table 1 about here.

---

We also developed versions of the pictorial portion of the instructions in which we intended to emphasize these same categories of information. For example: locative information was emphasized by

the use of arrows and dotted lines to show the spatial relationship or orientation of objects; brackets and a numerical or letter code were incorporated into the pictures in an attempt to emphasize referential information; and, the steps of the assembly were depicted separately in a series of pictures which were intended to be presented sequentially. The validity of this manipulation is currently, being determined in a manner similar to that described earlier.

Our analyses of "core" information and our attempts to manipulate predominant information types, confirmed intuitive yet important observations regarding research on picture-text procedural materials. First, because of the linear nature of text, "core" sequential information is inherent in the text and cannot be manipulated without destroying the integrity of the instructions. However, such information can be emphasized by the addition of words or phrases (such as "first", "next", "finally", etc.) which have low semantic value with respect to the information necessary for full comprehension and performance of the task. Pictures do not share this linearity of presentation. Similarly, "core" locative information is inherent in pictures and also cannot be manipulated without changing the essence of the message conveyed.

Findings such as these have influenced our investigation into the optimal use of picture-text combinations as vehicles for presenting information in procedural instructions. Our current research capitalizing on these insights and using the methodologies described above, is investigating the effects of redundancy of locative information in both text and pictures, on comprehension and memory.

References

Bransford, J. D. & Johnson, M. K. Considerations of some problems of comprehension. In W. G. Chase (Ed.), Visual information processing. New York: Academic Press, 1973.

Chall, J. S. Learning to read: The great debate. New York: McGraw Hill, 1967.

Dee-Lucas, Diana A guide to the analysis of text. Unpublished manuscript, Cornell University, 1978.

Frederiksen, C. H. Representing logical and semantic structure of knowledge acquired from discourse. Cognitive Psychology, 1975, 7, 317-458.

Fries, C., Fries, A., Wilson, R., & Rudolph, M. To teach reading: A manual and guide for a basic reading series. Ann Arbor: University Press, 1965.

Glaser, Robert Trends and research questions in psychological research on learning and schooling. Educational Researcher, 1979, 8(10), 6-13.

Gombrich, E. The visual image. Scientific American, 1972, 227(3), 82-96.

Halbert, M. An experimental study of children's understanding of instructional materials. Bureau of School Service, University of Kentucky, 1943, 15(4), 7-59.

Hochberg, J. Studies in reading. Project Literacy Reports, No. 9, Ithaca, NY, 1968, 25-37.

Kintsch, W. The representation of meaning in memory. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1974.

Koenke, K. R. The roles of pictures and readability in comprehension of the main idea of a paragraph. Paper presented at the annual meeting of the American Educational Research Association, Chicago, February, 1968.

Mackinnon, A. How do children read? Toronto: The Copp Clark Co., 1959.

Meyer, B. J. F. The organization of prose and its effects on recall. Amsterdam: North Holland Publishing Co., 1975.

Miller, W. Reading with and without pictures. Elementary School Journal, 1938, 38, 676-682.

Samuels, S. J. Effects od pictures on learning to read, comprehension, and attitudes. Review of Educational Research, 1970, 40, 397-407.

Stone, D. E. Comprehension of information in picture-text amalgams in procedural texts. Unpublished Doctoral Dissertation, Cornell University, 1977.

Stone, D. E. The semantic content of text, pictures, and events. Paper presented at the Symposium on Research in Graphic Communication, The Open university Reading Research Group, Oxford, England, May 25, 1978.

Vernon, M. D. The value of pictorial illustration. British Journal of Educational Psychology, 1953, 23, 180-187.

| | Unemphasized Information | Emphasized Information |
|---|---|---|
| Locative Text | 249.11 ms. | 283.3 ms. |
| Referential Text | 232.81 ms. | 301.92 ms. |
| Sequential Text | 268.48 ms. | 175.00 ms.(Note 1) |
| Neutral Text | 286.91 ms.(Note 2) | NA |
| TOTAL | 264.56 ms. | 284.26 ms. |

Table 1. Mean duration of eye fixation on emphasized and unemphasized information in four text conditions.

Note 1. In the text where sequential information is emphasized, that information is of little semantic value. In the locative and referential conditions, the emphasized material is very important in comprehending and remembering the instructions (i.e. of high semantic value). This may account for the substantial difference in fixation duration between sequential and the two other emphasized conditions. (The mean fixation duration for emphasized material in the locative and referential conditions combined was 298 ms..)

Note 2. Notice that the mean duration of fixations for unemphasized information is considerably higher in the neutral condition, where none of the information was emphasized. This suggests the possibility that emphasis in the other conditions attracted attention to the emphasized information and away from the unemphasized information.